December 13th, 2005
Group A:

Members:

Table 1

Name	Company	Area of Interest	12/13	12/14
Kevin DeGroat	McNeil Technologies	Facilitator	X	X
Terry Sullivan	BNL	Note Taker	X	X
Tanya Blalock	Georgia Power		X	
John Cromwell	Stratus Consulting Inc.,	Climate variability	X	X
Linca Church-Ciocci	National Hydropower Assosciation		X	
Susan Hutson	USGS		X	X
Jim McMahon	LBNL	Policy and Economics	X	X
Kenya Crosson	Brookhaven National Lab		X	X
Bill Bryson	Groundwater Protection Council		X	X
Stuart Gaffin	Columbia Univerisity	Climate change	X	X
Bud Badr	SC Dept of Natural Resources		X	X
Randy Gentry	University of Tennessee		X	X
Joseph Kula	URS Corporation		X	X
Bryan Stockton	ML Strategies, Inc.		X	
Jim Kundell	University of Georgia		X	X
Neol Gollehon	USDA	Economic Research	X	
Brett Bower	American Water	Economics - Energy	X	
Nick Woodward	DOE – Office of Science		X	
Stephanie Tanner	EPA	Office of Waste Water	X	X

December 13th

Energy Extraction

Varies geographically (more mining in W.Va, Pennsylvania)

- Two categories, extraction waters can not be used and must be disposed. Or potentially useable water that is not allowed due to regulations. For example coal-bed methane water does not fit into oil and gas waters. Coal-bed methane becoming larger.

– Coal bed methane requires a lot of water to develop the wells then the water falls off due to consumption? Becomes a resource allocation problem with farmers. Can lead to surface groundwater problems. Surface to groundwater impact. More of a problem in arid regions. Not studied much in East. Uncertainty on whether this is an issue.

– Strip mining changes hydrology of the area in West Virginia. It impacts water quality as well as increase run-off. .

- Strip mining is increasing in Tennessee, coal washing impacting water quality.

– …climate variability, climate change. More intense and more frequent precipitation events leading to larger impacts on run-off and hydrology.

– USGS study in Tennessee on increased intensity of precipitation events. […will provide a reference]

– …use of water from coal-mines for power plant needs. Water quality issues, acid mine. Map of coal region could provide scope of problem.

– If you use mine drainage, you impact regional hydrology and this must be understood.

– Expect increase reliance on coal mining and thus problems associated with acid mine drainage (and potentially reuse) will grow.

– [You] could interface coal map with other layers of land use, urban density, etc. to see the impacts.

– In mine regions, most communities can not rely on local groundwater. [You} must get water from other areas. This is an existing problem. This could grow as we mine more coal.

– May be a base of knowledge to integrate to understand these problems?

May be a knowledge gap on the problem.

Fuel Production

Coal washing, management of coal mine wastes, transportation.

– …management of mining wastes, impoundments, water quality issues in mining areas, failure of impoundments…

– Climate change will lead to more impoundment failures. They may not be designed for future weather conditions.

– [You] can not tell local impacts of climate change. In principal, rainfall will remain relatively constant, but more high rainfall events and longer droughts.

– Hydrogen. Hydropower for the production of hydrogen. To produce through electrolysis, you need a lot of water. Hydrogen production will also be high energy consumption. If we go to hydrogen fuel cells for transportation it will impact both energy and water use greatly. Growing competition on the water source... Do not have a quantity of water used.

– To produce total amount of hydrogen to replace gas for transportation the energy demand would be equivalent to all of the coal and natural gas. It would require 400 nuclear power plants this is 80% of current energy usage.

– Water used for hydrolysis will be small part of water budget. Primary water use will be primarily from energy production.

– Where does water vapor go with hydrogen fuel?

– What is the increase in water vapor emissions (current fuel emits some water vapor)?

– Another advantage of hydrogen fuel cells is that it is distributed generation. Do not have energy costs associated with moving energy.

– If we go to distributed power production via fuel cells, reuse of water may become a bigger issue. Will this impact local municipalities?

– Check President's Hydrogen Initiative. It focuses on generation, transportation and storage.

– Hydrogen regulations will be more involved with safety (hydrogen explosion).

– Generation of electricity will be more regulated in the future. Thus if you have more power plants to produce hydrogen, it may be an issue.

– There is still oil and gas production east of the Mississippi. [There are] old fields with higher water content.   This will be a continuing problem.

- [The] problem will be localized and important from the region. Produced waters are brackish to saline. The water often contains metals as well.

– [What about] LNG water use? Unknown, but believed to be low.

– Biofuels. High use of water for agriculture. More of an issue in Nebraska and Kansas – Central Region. In East, would use woody materials for biofuels. Use of biofuels will grow.

Electricity Production

– Less water available due to competing demands.

– In hydropower, water availability is a major issue in licensing of new plants. Most hydropower is from rivers. Growing need for recreation, flows for fish and wildlife, flows for aesthetics, flows for agriculture. Recreation is the fastest growing area. Climate change is a huge issue for hydropower (how to handle large storm events).

– Increase or decrease in power production

– Only 3% of dams have hydropower. Significant amount of energy could be generated (41000 MW).

– [In] some USGS systems, water consumption has a fee associated with use.

– Increased sedimentation due to higher rainfall events…will cause a problem for dams, hydrology, etc.

– [We] need to enhance forecasting ability to predict water inputs from precipitation. [We] need to enhance both long and short-time forecasts. (*** Make it clear that Bud said I was right).

– [It is] harder to forecast in the East because we do not rely on snow pack.

– Due to competition, Hydro may not be used for load following.

– Long-term we need to think about different sources to handle peak loads. (Pumped storage)

– Interbasin transfer of power produced using water in one region to another. "Water moving by wire" [is a] huge issue in Central Region. Not recognized in the East.

– We can produce 3 times as much energy per gallon of water today than we could in the 1950's due to closed loop plants.

Dry cooling penalties.
Start up costs of changing technology (retrofit costs).
New technologies not being deployed in new plants.

– Gas cooled turbines used for peak load were not permitted in Tennessee due to water consumption. [This is] No longer true.

– Conjunctive use of water. South Carolina has an extensive monitoring network for ground and surface waters. South Carolina State Water Plan – reference.

– Many unknowns on groundwater availability. Poor characterization.

– Unknown recharge rates due to variability makes characterization of groundwater quantity difficult.

– Water availability is a lead factor in siting a plant. Not as big a problem as out west, but it is important. [It is] pushing utilities to consider waste water systems.

– Surface water is available but not necessarily when it is needed. Therefore, use groundwater as bank for times of low flow.

– Clarification between consumption and use [is needed]. For example, hydro power has very little consumption, but high use of water.

– After use, return [is an] issue. What is the water quality of the returned water?

– Use of grey water for power production, water quality issues will be important. How grey is grey? What can be used, what amount of treatment is used?

– Problem in high growth areas [for]

– [In] 20 years, Georgia will be the 4th largest state, and Florida will be the 3rd largest state (replacing New York). 75% of population will be within 50 miles of the coast.

– Population growth area in the Piedmont region is expected but they do not have a lot of water.

– Pumped storage could be used for peak load following.

– Fish kill in water intakes can be reduced by screen size.

– Pumped storage [is] not economically feasible currently. Economics may change in the future.

– SCR for pollution controls does consume water.

- With projected new power production, we must lower emissions rates per unit of power to handle our own. This means more emissions control.

– Pressure to reduce Carbon emissions will lead to growth in hydropower and nuclear.

– Carbon sequestration by injection of power plant emissions below ground (deep-well injection)… may cause water pollution problems.

– Deep well injection of gas is a new technology.

– DOE prepared roadmap of carbon sequestration. Suggested supercritical CO2 injection in deep aquifers. (1999 report). Regulated as produced water injection by EPA… Used in West Texas, Kansas… Oil and gas industry use it for enhanced oil recovery. Not sure if this will scale up to sequestration of power plant emissions. It works on a small scale.

– Future Gen [will] remove CO_2 as part of gasification process.

Renewables

Wind and solar. Water production for solar cell production. Low water consumption.

Geothermal potential on East Coast low.

Biofuels major water user in renewables.

– Water suppliers want backup generators for reliability and perhaps peak shaving. [This is] small scale. If better technology on pollution control was available, it would help these technologies. [You] can not use the technology in parts of CA due to air pollution.

– barrier to hopping on and off the grids.

Anaerobic digestion of farm wastes. Problem in southeast. Anaerobic digestion used as nutrient. Used in wastewater treatment. Not economically viable currently in US.

– Anaerobic digestion can be used for nutrient management.

Farm wastes may impact Chesapeake watershed and other key water supplies. Maryland started assessing a fee for nutrient removal from farm wastes.

Water Supply

Urban Uses

– Water quality.

– Population growth in the Southeast. Georgia will add 4 million in population in the next 20 years.

– 1 million in 20 years for South Carolina

Reference US Census Bureau (SH will supply).

– more non-point source uses of pollution

– Urbanization in headwaters or rivers reduces infiltration and impacts hydrology.

– Desal in Tampa Bay, VA and other coastal areas… Many cities are considering using desal water to avoid siting issues. [This is an] alternative supply of water. Desal [is] energy intensive.

– [There is an] aging trend; as population ages, [then] water/energy uses are more intensive per capita than larger houses.

– Aging infrastructure [is a problem]. Philadelphia loses 40% of water during water transportation. This is a growing problem.

– EPA funding for infrastructure has been stopped. EPA study on infrastructure gaps for waste water indicates a billion dollar shortfall over 20 years. ST will supply reference.

– How much energy does it take to recharge under impervious surfaces? How much energy are we wasting for 40% loss of water in Philadelphia?

– Urbanization leads to more power/water demands and degraded water quality.

– [Consider] Industrial users of water. Large industries have their own water supply wells.

– Industrial withdrawals have declined, but industry is shifting to public supply.

– [There is a] knowledge gap on how water is being used by various sectors. EIA data for power usage, [exists] but nothing [is available] for water use. Lack of unified data set to address water use issues, lack of cost data, very few analytical tools, etc

– Reporting requirements and data accessibility very different on a state by state basis (particularly out west where water rights are protected). [There is a problem of] data proprietary in some cases. States with reporting requirements do not always enforce or analyze data due to funding limits. Data management issues are a problem.

– Accuracy of water data is a question. Data from pump tests, metered, etc.

– SC quarterly report on water usage greater than 100,000 gpd

Large water withdrawals and property rights

Water rights are a key economic development issue.

– As demands for water increase, the need for better quality and more data increases.

– Withdrawal [is] often measured as power consumption.

– Over last 15 years, quality and quantity of data decreases.

– As water uses change, who gets access to the water? Are there procedures in place to reallocate the water?

– Georgia paper mill went bankrupt. The judge ruled that the water rights were an asset that could be sold. The State protested that this was not consistent with water laws in the State.

All states are trying to come to grips with property rights. Some states are thinking about developing water laws.

Reference J. Kundell – 2 reports done for EPA Region 4 on State water laws in the Southeast.

– Increase in population leads to increased demands for environmental quality. In particular, recreational use of water increases. [There are] synergistic effects between urban growth and water needs for multiple uses.

– Small cities and municipalities [are] trying to lock in water supplies. [There is] little coordination between small cities. So each city fights for whatever they can grab up.

– Small municipal supply systems in depressed areas with water quality issues. Repair may not be economically feasible, often hook up to public water supply. Speeds urbanization – people leave to go to the cities.

– [There is] more dependence of rural areas on urban areas. [They] often must compete for the same water.

Agriculture Irrigation and Uses

Competition between power and irrigation in the East.

– [For] Georgia this is not an issue. Irrigation is a groundwater issue in southeast Georgia. Growth in the north.

– Says that you are competing for the same water.

– Lake Seminole [is a], karst area. [It] has a lot of interchange from the lake and the groundwater.

– Georgia is unique. Everywhere else, there is competition between irrigation water and other uses of water. Competition depends on overlap of using the same water.

– Competition intensifies during droughts. Agricultural wells tend to be shallow and run dry in droughts.

– [There are] agricultural impacts on water quality…Nutrient and pesticide problems.

– Fertilizer production is from oil and natural gas.

– Much of the fertilizer we use in the US is imported. (Venezuela).

– Little water from hydropower reservoirs is used for irrigation. Some use in NE. Most irrigation is groundwater.

– Irrigation increases are due to golf courses, sod farms, landscaping. Irrigation for farms [is] relatively constant.

– Landscaping irrigation a big problem. Use of water at peak demand times and worst time for supplying power (summer, highest energy demands). Problem in Massachusetts and Minnesota.

– Irrigation is used for maximizing crop growth. In drought conditions the demand is higher. Climate variability may increase needs for irrigation.

NG – USDA reference on climate variability and need for irrigation.

- [There is an] irrigation risk reduction mechanism. Lending institutes [are now] requiring irrigation to lower their risks.

– Lack of consistent pricing structure for water. Economic drivers not there.

– EPA has a major initiative to get water pricing to reflect actual costs.

– Water is never priced according to its cost to produce.

– Deregulation leads to pricing structures. Spread out usage to non-peak times to lower costs. Water utilities could go to peak pricing to improve usage.

– California Energy Commission [is] looking at pricing water to peak shave. Water is the number one energy consumer in CA.

– Water delivery costs will increase with urban sprawl.

Will [the] public accept demand side management for water (e.g. peak pricing, rate structures, etc.)?

Public acceptance/knowledge of water or energy problems. Public does not see a connection.

- Do we need all water to be potable? Can we supply grey water for certain uses?

– Grey water is only needed part of the time (irrigate in growing season). What do you do with the water the rest of the year?

– Distributed systems. Cost of extending the lines is prohibitive for large systems. Research question is can we develop distributed systems that are reliable, sustainable, and cost effective. [There is a] problem of vulnerability of centralized processes.

– Water availability for distributed systems may be an issue. [Speaker believes] water utilities are efficient at managing costs.

– Many states want one large system to maintain scenic and recreational quality of the river as opposed to distributed systems.

– Growth in the East is in private wells and private septic tanks. Trade off is generally to go from groundwater supply to surface water supply in a large system. Need to pump, treat, and transport the water. This requires energy.

– New drinking water regs (compliance at the tap) is a more complex problem. Membrane treatment may work for distributed systems, but currently they are more energy intensive.

Energy Production

– Population driven plant siting problem. Population lives on the coast but will want to cite the plants away from the population: Not in my back yard (NIMBY).

– Cooling towers higher consumptive loss. However, this is the way of the future.

– Is evaporative loss from cooling towers the same as from stream discharges?

- I do not think so. Some evaporation loss in cooling.

– Once through cooling 3% consumptive loss (worst case). Closed loop systems 75% or greater consumptive use, however much less total water use. Open systems use much more water. Look at gpm or g/kw in terms of water use when comparing open and closed systems.

– Different definitions of use (i.e., Consumptive use, withdrawals, etc.) [It is] easy to measure withdrawal. Cannot subtract discharges from withdrawals as a measure of use.

– [You can] calculate losses in cooling towers with good accuracy.

Siting will change as new energy production is developed.

Recreational Use

Recreational and environmental demands will conflict with water usage for power plants.

– In some cases, conflicts are not lose-lose propositions. May provide access to new sites, release water for kayaking at times, etc.

– Balancing needs is difficult.

– New turbines use less water (hydropower).

– High value property issues may prevent water withdrawals for power.

– [There are] environmental flows required for species growth and sustainability. Tricky issue is taking water for use at one point and re-introducing the water at a different location. Flows impact navigation and species.

– [There are] flood inundations for fish species on a periodic basis.

Topics

Energy

a)	Produced water from coal extraction yxx	Short term - 2	Long term - 1
b)	Coal bed methane	Short term - 0	Long term - 0
c)	Strip Mining Impacts xx	Short term - 2	Long term - 0
d)	Underground Coal Mining yxxy	Short term - 2	Long term - 2
e)	Climate Change yxyyyyyyyx	Short term - 2	Long term - 8
f)	Hydrogen Production yyyyyyyy	Short term - 0	Long term - 9
g)	Oil and gas production issues	Short term -0	Long term - 0
h)	LNG water issues	Short term - 0	Long term - 0
i)	Biofuels production xy	Short term - 1	Long term - 1
j)	Thermal Cooling xxyxxxxxyx	Short term – 8	Long term - 2
k)	Hydropower Development xyxxyxxx	Short term - 6	Long term - 2
l)	Data and Modeling Issues xxxxxxx	Short term - 7	Long term - 0
m)	Population Growth xxyxyxyyyx	Short term - 5	Long term - 4
n)	Pollution control equipment leading to higher water demand xx 2		
o)	Carbon sequestration yyyyy	Short term - 4	Long term - 5

X = short term
Y = long term

Water

Table 2

	Short term	Long term	
Population growth	x	yyyyyyy	
Water supply technologies and energy costs			
Aging Population			
Aging Infrastructure	xxxxxx	yy	
Industrial Water Use			
Data, Modeling, and Communications	xxxxx	y	
Water Law and markets (cost pricing, ownership)	xxx	yyyyy	
Impact of urban areas (impervious surfaces, heat islands, urban growth and sprawl)	xx	yyy	
Irrigation (urban, fertilizer)	xxxx	y	
Climate change		yyyyyyy	
Use specific quality			
Distributed vs Centralized systems	x		

Drinking water regs			
Dam relicensing	xx	yy	
In stream uses (recreation, environment, fish, navigation)	xxxxxx	yy	

December 14th

Needs Assessment

Thermal Cooling

– [There is a] modeling need for allocating water between various uses (particularly during droughts).

– Review of details for groups identified needs

– Minimize water used for thermal cooling and minimize quality of water (produced waters, grey water) for cooling.

– Maximize use of energy (better thermal efficiency, better use of waste heat)

– Better quality assured data for EIA data base. Standard metrics and approach to collect data across the whole range of power plants.

– Current use is 21 gal/kWh for all plants (once through and recirculation). Short –term someone should take a detailed look at the data base to compare once through and recirculating cooling systems. No new plants will use once through cooling.

Collect data for cost of reducing water usage ($/gal saved).
Define terms (water use or water withdrawal, conditions (temperature, flow of water body over time, technology).
Goal of cutting water usage for once through cooling systems by 50%.
Goal of cutting water usage for recirculating cooling systems by 50%.

– Adoption of new technologies. Retrofit or at new plants.

– Problem with life cycle costs as plants are used beyond their originally licensed life (plant extensions)

– If we go to the Hydrogen economy, we will approximately double energy production. Thus, 50% lower water use would lead us to using as much water in the future as we currently use.

– Opportunity to reduce water usage in thermoelectric generation is greater than in other places.

– Technology transfer of thermoelectric heat transfer advances should be brought to smaller scale such as for buildings.

Use of lower quality water
What level type of water is acceptable (Water quality)? Need a uniform definition of what grey water is.
How many times can water be recirculated if it is of lower quality?
Acceptable Disposal Options of residues and waste water? Want to reduce volume of disposal to minimize costs.

Ground as cooling system (Germany).

Co-location of power plants and grey water sources.

Use of waste heat. Measures.
Need case studies where waste heat was used. Look to Europe for examples.
Determine what % increases are possible and at what cost.

– Need to determine what a 1 C change in temperature by 2050 will do to energy demand and plant efficiency.

Hydropower

– building water allocation models. Supply and demands on water. Supply, flow rate, water elevation over time on a weekly basis. Demands on water to specify the amount of water needed by each user (hydropower, fish and wildlife, recreation). Costs of reservoirs. Cost of hydropower development. Price of energy by time. Need long term data for inflow and outflow.

– These models exist for the Potomac and Delaware rivers and have been used for 25 years.

– [We] must consider climate change as that will change the system. Sedimentation rates will change particularly if you have more high intensity events. Temperature effects impact demand.

- [We] need to be able to downscale data to the basin level.

– [We] need to bring costs of monitoring down and [we need] data management.

- $10,000 per year for a real-time monitoring station on surface waters

– [We] need about 10 times as much data on surface water as currently available for predictive modeling.

- [We] need groundwater data as well. It does not need to be real time for groundwater.

– [We] need to do modeling to define data needs.
Groundwater costs $5K per year for O&M.

– [We] may need real time data in Karst systems.

– We often have more data than is needed to answer the questions being posed.

– At least one gauging station for each sub-watershed.

Needs – Model to define data needs. Building towards a real time model for operations.

– Where to place monitoring in groundwater is an open area of research.

– USGS is funding a modeling of the Karst system in the Shenandoah.

– Competing uses of water is key.

– Pumped storage [is needed] for maintaining levels during droughts.

– Costs/potential for rehabilitating hydropower systems (dredging)

Population Growth

– We only have population projection data on the state level. Need a more local level of growth. Better models of trends in population growth by water features (i.e. water basins).

– [We] need to know how many septic tanks exist. How many people [are] on public supply?

– No national survey on water use similar to EIA. AWWA studies focus on western US.

– Studies on benefits of water conservation on energy conservation [are needed].

Water heating is a big water/energy user.

Need better communication to utilities and communities about water/energy consumption.

Building codes and water distribution systems.

Green buildings. Promoting them in communities.

Model to show how people can optimize their water use.

- Case studies on use of water/energy efficient buildings. No one solution fits all. [It] depends on local conditions.

Hydrogen Economy

Water for hydrogen. Can it use lower quantity water.

Water needs for thermal power generation.

Implications of siting. What is the distribution system? LNG pipelines are currently being considered.

H_2O vapor releases.

Carbon Sequestration

Water needs for sequestration?
Quantity/Quality/Locations
Holding water use constant (energy penalty for separation of C).

Water Impacts?
What does reinjection do to groundwater.

Where can it improve ecosystems (forests)?

What are negative impacts? Metals,

Reference – CO_2 Storage by Oil and Gas Industry.

Aging Infrastructure

Leakage from existing systems.

Elimination of funding to EPA for infrastructure.

Not designed for modern uses.

Energy implications for accepting 40% leakage.

Need to quantify leakage from old water pipes and infiltration for waste water pipes.

Quantity/cost of energy and water losses from leaking pipes.

- Infiltration into waste water pipes.

- Geophysical methods for looking at pipe leaks.

- Improved metering to help define leaks. Automatic meter reading (AMR). Replacement of old meters.

- Pipe rehabilitation. No dig technologies. In-situ repair. Slip a liner into a leaky pipe.

- Need better quantification of water/energy losses to make compelling case for fixing pipes.

– New standard water loss model has been recently been released. A few water utilities are using this. Needs to get

– In situ pipe burst technology.

Upgrades of treatment and distribution systems.

- Alternative approaches to reduce the strain on the infrastructure. Avoidance approaches. Must be $ effective

– Green roofs need info on application impacts (how much energy saved, how much water saved, costs, maintenance,)

– funding mechanisms (low interest loans, ..) for promoting adoption of new technologies.

– Asset management is needed. Define problem. Prioritize and develop a plan to address this.

– use life cycle costs to perform asset management.

In stream uses

Navigation, recreation, environmental, ecological , property values, thermal cooling , hydropower, etc.

– Quantifying the problem is the key. Quantity of flow, temp, turbulence, flow variability, depth for navigation at low point under drought conditions.

– New models are needed in this area.

– Upgrade wastewater treatment to tertiary standards. Need less flow because you have higher quality water.

– Valuation of different uses of water.

Determine range of values for different decision elements (value of navigation, etc.)

– legal dimension. For example, endangered species act may require an action to preserve a species even if the valuation of other aspects of use are higher.

Needs – Comparable metrics

- Impacts of climate change
- Technologies to deal with extremes (pumped storage, aquifer storage and recovery, reservoirs)
- Legal aspects
- New models for decision support

– adaptive management is needed.

Water Laws and Markets

- Water and energy needs at a regional level (watershed versus state).

– Better defined water laws on interstate issues.

– Need to tighten up state water laws in the East. Do not want to go as far as the west has gone in guaranteeing surety of water supply. Need to adapt to changes.

– Compacts put together 25 years ago did not consider current uses and are outdated.

– National water commission with state water managers [needed] to facilitate regional planning

– ICWP committee.

– Water policy is divided among dozens of federal agencies. National water policy could set national standards for water use issues.

SOLUTIONS

Data Baseline

Canvass states. Good quality data at state level. Identify good data practices as a template for others.

Characterize: water usage by topic (power, agriculture, domestic).
QA (quality flags)
Hydrologic data (flow rates, depths, etc.)
Need infrastructure (data base management) system. GIS capabilities.
Data sharing between different groups.

Data collection go to USGS, State land grant colleges, State Geological Services.

- Political issue of water use (agriculture does not report use).

Ref – National Research Council report on water uses.
EPA puts out report to Congress on groundwater every few years.

Solution is to collect and analyze what is available for analyzing water needs problem. Need coordination between different data sets.

Clearing house for data. Simplest level would be a web page with links to each state and what each is doing.

a) Water Resources Council/ Information Agency
b) Data co-ordination
c) Data availability (web page links)
d) Mechanism for standardization of data.

Clearing house
Assessment of available data
Use existing data for policy level decisions.

Collect water data of the same quality as energy data. Useful for long term planning. Need to place a value on water to make this useful.

Technology Assessment Guide for water technologies.

Demonstration of successful technologies. Demonstration of economics of water conservation.

Technology Adoption –

- Tech transfer model for Petroleum Technology Institute funded by DOE.

For tech transfer need water users, agriculture representatives, water equipment suppliers, state water department, city managers. Environmental Technology Verification focused on water and water efficiencies.

– [We] need to integrate different players in the energy water nexus region. Water utilities, electric utilities, PSD’s, water/energy conservation.

Pricing Mechanism

Realistic pricing of water is essential to drive the process for technology adoption of new technologies.
Feedback to let consumers know how much water/energy they use.
Time of use pricing. Value of reducing peak consumption
Water Loss Audit. New International Standard for estimating water losses through the pipes. Has benchmark and economic analysis of the costs to repair.

Climate Change Solutions

Assessment of impacts of climate change on baseline due to 1 C change by 2050, with more intense precipitation events.

How does climate change effect comparative advantages of different solutions.
Develop a risk reduction strategy.
Sensitivity analysis on impacts of climate change.

Insurance companies are looking at impacts of climate change on their business.
NOAA reference. NOAA has a hydroclimatology division that has just been started.

Population Growth Solutions

Must have holistic solutions. Can not work only on a single issue.

Assessment of impact of population growth on water resources. Water demand and changes in land use that change hydrology.

Decentralization with smaller modular plants.

Better control of pumping rates to minimize energy usage.

Smart growth. More rigorous zoning and control of land use.

Incentive/finances to support smart/growth.